WORK PLAN AND METHODOLOGY

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Reconstruction- Based SRR Algorithm:

There are a number of different algorithms developed to perform SR reconstruction. These include non-uniform interpolation, frequency domain, deterministic and stochastic regularization, and projection on to convex sets (POCS), hybrid techniques, optical flow, and other approaches.

1. **Non Uniform Interpolation :**

This approach is the most intuitive method for SR image reconstruction. The three stages presented in Fig. 2 are performed successively in this approach : (i) estimation of relative motion, i.e.,registration (ii) non uniform interpolation to produce an improved resolution image; and (iii) de-blurring process. This method has low computation and can be used in the real-time system but the degradation models are limited, therefore, this algorithm can apply on few applications.

2. **Frequency Domain Approach :**

The frequency domain approach makes explicit use of the aliasing that exists in each LR frame to reconstruct an HR image. The Super resolution Reconstruction idea was first presented by Huang and Tsai (1984).They proved that in absence of noise or blurring it is possible to reconstruct a HR image from multiple LR images based on the aliasing present in the LR images. This was accomplished by relating the aliased discrete fourier transform coefficients of the LR images to a sampled continuous fourier transform of an unknown HR image. Kim and Bose extended this to blurred and noisy LR images, provided the noise has zero mean and the blur and noise are identical across all LR images. This was accomplished using a recursive implementation based on the weighted least square theory.

3. **Regularization :**

Typically, the SRR algorithm is an ill-posed problem due to an insufficient number of LR images and ill-conditioned blur operators. Procedures adopted to stabilize the inversion of ill-posed problem are called regularization. In this section, deterministic and stochastic regularization approaches for SRR algorithm are presented. Traditionally, constrained least squares (CLS) and maximum a posteriori (MAP) SR image reconstruction methods are introduced.

4. Projection Onto Convex Set :

The POCS approach describes an alternative iterative approach to incorporating prior knowledge about the solution into the reconstruction process. With the estimates of registration parameters, this algorithm simultaneously solves the restoration and interpolation problem to estimate the SR image. The POCS formulation of the SRR was first suggested by Stark and Oskoui (1989).Their method was extended by Tekalp, et al.(1992) to include observation noise. Although POCS is simple and can utilize a convenient inclusion of a priori information, this method has the disadvantages of non-uniqueness of solution, slow convergence and a high computational cost.

5. Optical flow :

Some applications can benefit from the generalization of SR techniques to support the imaging of objects that are non-planar, non-rigid, or which are subject to self-occlusion when rotated. One such application is SR reconstruction of facial images. Baker and Kande present optical flow as a solution to this problem. Zhao and Sawhney present a comparison of three different flow methods: least-squares based flow , consistent flow (CONS), and bundled flow with CONS flow as initial input. They demonstrated that it worked well when small amount of noise were present, but that it w as very sensitive to flow accuracy.

Hence we propose

- the data error term L_1 norm in SR reconstruction which results in robust result in error estimation than L_2 norm.
- L_1 norm minimization is the ML (Maximum Likelihood) also known as back-projection algorithm estimate of data in the presence of Laplacian noise.
- the ML estimator is usually very sensitive to noise , registration estimation errors and PSF estimation errors.
- therefore proper regularization on the feasible solution space is always desirable. Hence this leads to SR reconstruction based on MAP
- Commonly used image priors for the SR reconstruction under MAP are
    i. Gaussian Markov Random Field (MRF) commonly known as Tikhonov regularization.
    ii. Huber MRF
    iii. Total Variation(TV)

- Hence TV norm is very popular in image denoising and deblurring and therefore we propose the so called **Bilateral TV for robust regularization.**

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- Collect the no of BMP image frames, and for given no of iterations find their vertical and horizontal shift for no of blocks in image.
- Further we will divide the frames in number of blocks as per the requirement.
- Further the blocks are down-sampled.
- To register the image median shift and add method is employed, i.e. we register the image sequence to get the final image.
- We then convolve the above with point spread function of camera and add the Gaussian noise of some variance to it.
- All of the above terms are added and this is minimized as the function of X. The minimized value of cost function is our HR image.